

What Is Claimed Is:

1. An apparatus for extruding and cooling polymeric sheet materials, said apparatus comprising:

a polymer sheet extruder having heating means connected to a die designed to preform and produce along a machine direction initially softened and heat-plastified polymeric sheets of predetermined thickness;

a plurality of cooling rolls positioned along said machine direction and downstream of said heating means, a gap between said cooling rolls being positioned in concert with feed means for introducing said sheet into said gap, each said cooling roll having a longitudinal axis of rotation and being capable of cooling a heat-plastified polymeric sheet produced by said extruder;

or displacement means connected to at least one of said rolls, said displacement means being mounted for selective displacement with respect to another of said cooling rolls, said cooling rolls being positioned on opposite sides of and adjacent to said gap such that the axes of rotation of said rolls provide a tangential point for movement of said sheet between said cooling rolls, each opposed said cooling roll being mounted in a frame for axial rotation; and

a laser source connected for measuring directly and without reflection, and while said sheet is processed through said gap, the thickness of said gap, said laser source being aimed in said machine direction and emitting a laser beam aimed and arranged for transmitting a beam of laser light tangentially into and directly through said gap and through said tangential points of said cooling rolls;

a corresponding laser beam detector positioned and aimed in line with said gap on a side of said cooling rolls directly opposite to said laser source for non-reflectively measuring, while said sheet is processed through said gap, the amount of laser light passing directly through said gap;

means for comparing said measured value to a desired value corresponding to a desired gap width; and

a controller responsive to said measured value for controlling said gap distance through selective linear roll displacement;

wherein said adjacent rolls are positioned at a controllable distance for passage of said softened and heat-plastified polymeric sheet to apply minimal stress level to said polymeric sheet while said rolls exert a cooling effect to cool and solidify the previously softened and heat-plastified polymeric sheet.

2. The apparatus of claim 1, wherein a plurality of gaps are present, each with a laser source and a laser detector, and wherein each said laser source emits a laser beam, and its corresponding laser source and its corresponding laser detector are located at opposite sides of said gap between said adjacent rolls.

3. The apparatus of claim 1, wherein said cooling rolls are arranged in a stack which is oriented in a vertical orientation.

4. The apparatus of claim 1, wherein said rolls are arranged in a cooling stack which is oriented in a horizontal position.

5. The apparatus of claim 1, wherein said rolls are arranged in a cooling stack which is angled between a horizontal and a vertical orientation.

6. The apparatus of claim 5, wherein said cooling stack comprises three cooling rolls.

7. The apparatus of claim 5, wherein said cooling stack comprises three cooling rolls, and said laser source and said corresponding laser detector are positioned adjacent two adjacent cooling rolls, and oriented physically to measure directly said gap therebetween.

8. A method of extruding a polymeric sheet, comprising the steps of:  
heating and extruding a polymeric sheet having a predetermined thickness to provide

a soft and heat-plastified sheet of uniform thickness;

controllably introducing said heated, soft and heat-plastified polymeric sheet into a gap extending between a pair of adjacent cooling rolls;

measuring the thickness of said gap directly and without reflection between said adjacent cooling rolls, by aiming a laser beam into and through said gap to fall upon a corresponding laser detector;

comparing the measured gap thickness to a desired gap thickness;

adjusting said gap thickness by linear displacement of said cooling rolls, in response to said measured gap thickness and said desired gap thickness; and

wherein said cooling rolls are adjusted to exert minimal pressure on said softened and heat-plastified polymeric sheet to cool the same.

9. The method of claim 8, further comprising the step of maintaining the pressure of said rolls between about 20 and 1000 pounds per linear inch of roll width throughout the sheet cooling period.